

IN THE FIGURES

Please amend FIG. 11. Specifically, the notations relating to focal lengths have been added as were set forth in the provisional application (to which priority is presently claimed) and which was incorporated by reference by the present application. The amendments to the figures are further supported by the amendments to the specification as indicated below.

REMARKS

I. INTRODUCTION

In response to the Office Action dated December 28, 2005, claims 6, 8, 16, 26 and 28 have been amended, claims 1-5, 12-15, and 21-25 have been cancelled, and claims 33-43 have been added. Claims 6-11, 16-20, and 26-43 remain in the application, claims 1-5, 12-15, 21-25 have been cancelled. Entry of these amendments, and re-consideration of the application, as amended, is requested.

II. CLAIM AMENDMENTS AND 112 REJECTIONS

Applicants' attorney has made amendments to the claims as indicated above. These amendments were made solely for the purpose of clarifying the language of the claims, and were not required for patentability or to distinguish the claims over the prior art.

Applicants further note that the previously entered amendments relating to 2D plane waves were fully supported in the specification as set forth in the prior response. Nonetheless, in the interest of expediting prosecution, Applicants have removed the objectionable language. Further, all of the ~~above-identified~~above-identified amendments are clearly supported by the specification as filed.

In addition, Applicants note that with respect to new claims 33, 36 40, and 44-46, the lenses in the second imaging relay lens pair are separated by the sum of each lens' focal distance (f_3 and f_4), and the lenses in the third imaging relay lens pairs are separated by the sum of each lens' focal distance f_5 and f_6 noted in amended FIG 11. Based on such focal distances as illustrated in the figure, it may be concluded that the reference beam split from a collimated laser beam is still collimated when it impinges on the photorefractive crystal. Further, support for such claims was found in the original filed provisional application to which priority has been claimed and which has been incorporated by reference (i.e., Fig. 4 of 60/535,205 filed on January 9, 2004).

III. RESTRICTION REQUIREMENT

The restriction requirement set forth in the prior Office Action has been made final. While Applicants traverse the restriction requirement, Applicants have cancelled the non-elected claims in the interest of expediting prosecution.

IV. PRIOR ART REJECTIONS

On pages (3)-(4) of the Office Action, claims 6-11, 16-20, and 26-31 were rejected under 35 U.S.C. §103(a) as being unpatentable over Yamaji et al. (Yamaji), U.S. Patent No. 6,088,31, in view of Gladney et al. (Gladney), U.S. Publication No. 2004/0090899.

Specifically, independent claims 6, 16, and 26 were rejected as follows:

As to claims 6, 7, 8, 10, 16, 17, 19, 26, 27, 28, and 30, Yamaji discloses a holographic memory system comprising: (a) a photorefractive crystal (10 of Fig. 10) configured to store holograms; (b) a single laser diode (1 of Fig. 10) configured to store holograms; (b) a single laser diode (1 of Fig. 10) configured to emit a collimated laser beam to both write to and read from the photorefractive crystal; and (c) one or more mirrors configured to steer a reference beam (5 of Fig. 10), split from the collimated laser beam, a high speed to the photorefractive crystal. Yamaji does not teach the mirror being MEMS.

However, Gladney teaches such a mirror for scanning the reference beam (see Fig. 9).

It would have been obvious, at the time the invention was made, to a person having ordinary skill in the art to utilize the mirror of Gladney in the invention of Yamaji since the MEMS mirror is efficient compact and consumes low power.

Independent claims 6, 16, and 26 are generally directed to a holographic memory system. More specifically, a photorefractive crystal is configured to store holograms. Further, a single laser diode is configured to emit a collimated laser beam to both write to and read from the crystal. The collimated laser beam is split and produces a reference beam. MEMS mirrors are then used to steer the reference beam to the crystal to read or write an entire page of data.

Applicant traverses the above rejections for one or more of the following reasons:

(1) Neither Yamaji nor Gladney teach, disclose, or suggest the ability to write a page of data to or read a page of data from a Photorefractive Crystal (PRC) in the manner claimed.

The amended claims provide that the single laser diode is configured to emit a collimated laser beam that both writes a page of data to and reads a page of data from the PRC. The various additional components of the system further enable such page writing capability. For example, the claims now provide for using a Spatial Light Modulator (SLM) to encode the page of data and an

imaging relay lens pair to image an SLM image on a plane behind the PRC. Such express limitations are wholly and completely lacking from both Gladney and Yamaji. In this regard, neither of the references enable the page writing/reading capabilities using images, the SLM, the image relay lens pair, and MEMS mirrors as claimed.

(2) There is no motivation to combine Yamaji with Gladney

The Office Action's suggestion for why an ordinary person might combine Yamaji and Gladney is incorrect. MPEP §706.02 states "there must be some suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify the reference or to combine reference teachings". The Office Action states the motivation to use MEMS mirrors is for efficiency, compactness and low power consumption. However, these motivations are not cited in any of the references, nor are they generally available to one of ordinary skill in the art.

In addition, neither Gladney nor Yamaji suggest a motivation to modify Yamaji to utilize the mirror of Gladney. Gladney chooses to use MEMS mirrors to solve the problem of steering multiple wavelength signals into a photorefractive crystal (see Gladney page 3 paragraphs 25, 26 and Figure 9). The solution requires a MEMS array of mirrors that can be independently tilted, intercepting the object beam and the reference beam, to reflect N different wavelength beams at N different angles or positions in space (see Gladney page 3 paragraphs 25, 26 and Figure 9). In other words, MEMS is a desirable technology because it provides for arrayed and independently tiltable mirrors.

While such independent tilting functionality may be desirable in the field of wavelength division multiplexing and bit stream storage, it is not necessary for storing pages of data as set forth in Applicant's amended independent claims 6, 16 and 26. In this regard, Applicant's use of the MEMS results in superior beam quality or reflectivity (see paragraph [0087]). Such an advantage is neither described or provided via the teaching of Gladney. In fact, Gladney teaches that the MEMS mirror could be replaced with a grating (see p3 paragraph [0025]). However, as described in the present specification (i.e., at paragraph [0087]), such a grating and diffractive elements would produce lower quality beams. Consequently, Gladney actually teaches away from the use of MEMS mirrors as claimed. Further, there is no motivation or suggestion, taught by either Gladney, Yamaji

or the Office Action, to utilize Yamaji with a MEMS mirror and arrive at the Applicant's amended claims 6, 16, and 26.

(3) Gladney teaches away from Applicant's amended claims 6, 16 and 26 and from Yamaji.

"A reference is said to teach away when a person of ordinary skill, upon reading the reference, would be discouraged from following the path set out in the reference, or would be led in a direction divergent from the path that was taken by the applicant" See *In re Gurley*, 27 F.3d 551, 553, 31 U.S.P.Q.2d 1130 (Fed. Cir. 1994).

Gladney explicitly teaches the omission of a spatial light modulator (see p 2 paragraph [0017]) "Further, interference patterns are created directly from the data bearing object beam, avoiding the need for providing and controlling an SLM". However, Applicants amended independent claims require such an SLM. Further, Yamaji also requires the use of an SLM (see Yamaji col 7 line 13, Figures 1, 10 and 11).

In addition, Gladney teaches de-multiplexing the input and reference laser beam into at least 40 wavelengths (see Gladney p 3, paragraphs 25, 26 and Figure 9). Each of the de-multiplexed beams taught by Gladney will therefore be at least 40 times smaller in diameter than a non-demultiplexed beam. On the other hand, Yamaji's system using a spatial light modulator, will require an expanded laser beam diameter (see Yamaji col 7 lines 10-16). Accordingly, a person of ordinary skill, seeking to use a spatial light modulator as in Applicant's amended claims 6, 16 and 26, would be discouraged from following Gladney.

Further, because, of such a teaching in Gladney, Gladney actually teaches away from being combined with Gladney. Thus, Gladney cannot be combined with Yamaji.

(4) Even if combined, a combination of Yamaji and Gladney would lead to an inoperable device.

"If when combined, the references would produce a seemingly inoperable device" then they teach away from their combination. (*In Re Gurley*, 27 F.3d 551, 553).

Applicants reassert (as indicated above) that Gladney cannot be combined with Yamaji. Nonetheless, even if combined, the resulting device would be inoperable and therefore teaches away from the combination.

Gladney teaches focussing the reference beam, after reflection from the mirror, onto the photorefractive crystal (see Gladney p2 paragraph 17, and page 3 paragraphs 25 and 26). Accordingly, the rays would not be parallel. Yamaji, on the other hand, requires the reference beam to emerge from the mirror as parallel rays (see Yamaji col 7 line 33, Figures 1,10, and 11). If the rays are not parallel, the reference beam will not be modulated correctly by the spatial light modulator and the stored hologram will be deformed or saturated (see Yamaji col 2 lines 49-54).

In addition, Gladney teaches changing the angle between the input beam and reference beam during hologram recording in synchronism with the bit pattern conveyed by the input beam (see Gladney p2 paragraph 19). Such a teaching means changing the angle after every bit received in the optical stream, typically at a rate of at least 1 Gigabit per second, or every nanosecond (see Gladney p 3 paragraph 27). In Yamaji however, the angle rate of change is pre-determined by a controller to ensure the irradiation time is adequate to form a hologram (see Yamaji col 8 lines 8-13). If the angle is changed at any other rate, for example every nanosecond, rather than at a rate calculated to ensure an adequate irradiation time, a hologram will not form. Thus, Gladney's teaching of changing the angle after every bit is wholly inconsistent with Yamaji's determination by a controller based on irradiation time. Such contrasting and contradictory teachings clearly illustrate they teach away from each other. Further, an operable device would not and could not be produced by combining Gladney with Yamaji.

(5) Neither Yamaji nor Gladney, either alone, or in combination, teach, disclose, or suggest the use of an imaging relay lens pair positioned between the spatial light modulator and the photorefractive crystal to image an SLM image on a plane behind a PRC.

Under MPEP §2142 and §2143.03 "to establish prima facie obviousness of a claimed invention, all the claim limitations must be taught or suggested by the prior art". The combination of Yamaji and Gladney would lead to a single Fourier Transform (FT) lens positioned between the SLM and the PRC (see Yamaji, lens labeled 9 in Figure 1) in addition to the use of Gladney's MEMS mirror (see Gladney Figure 9, p3 paragraph [0025], p2 paragraph [0019]) to steer Yamaji's reference beam onto the PRC.

However, such an FT lens would converge the input beam onto the PRC and thereby form an image in the PRC as a Fourier Transform image (see Yamaji, col 7 lines 20-26). However,

Applicant's amended claims require an imaging relay lens pair (labeled L1 and L2 in amended Figure 11) positioned between the SLM and the PRC. The imaging relay lens pair would converge the input beam onto the PRC, but sharply image the SLM image behind the PRC. In this regard, the claims explicitly set forth that the image is behind the PRC, not in the PRC. Thus, the prior art combination teaches the use of an FT lens to converge the input beam onto the PRC while the present invention relies and claims the use of an imaging relay lens pair to converge the input beam onto the PRC. Further, such lens usage would result in convergence of the input beam onto the PRC in front of different planes. The present claims expressly provide for converging the input beam onto the PRC in front of a particular plane that is distinguishable from Yamaji's FT plane and the description in Gladney. Accordingly, neither Yamaji nor Gladney teach, disclose, or suggest various specifically claimed limitations.

Distinct advantages are presented by the use of the imaging relay lens pair verses a single FT lens. Firstly, the use of an imaging relay lens pair provides for a simplified apparatus. To provide results similar to that claimed, an extra controllable SLM would be required in Yamaji (see Yamaji, col 8, lines 62-67 and col 9 lines 18-25). In this regard, the combination of Yamaji and Gladney leads to an input beam intensity distribution in the PRC consisting of spots (see Yamaji Figure 2 and col 8 lines 49-61), which causes deformation of a reproduced image if the reference beam is not spatially modulated with a spatial light modulator (see Yamaji, col 8, lines 62-67) in an actively controlled manner (see Yamaji col 9 lines 18-25 and col 10 lines 4-8). For example, the transmittance of the reference beam SLM would have to be controlled electrically at the time of recording (see Yamaji col 9 lines 18-25).

Applicant's amended claims 6, 16, and 26 on the other hand, lead to a uniform input beam intensity distribution and a reference beam that does not need to be spatially modulated. In addition, a "hologram recording/reproduction apparatus" using a single Fourier Transform lens as taught by the combination of Yamaji and Gladney requires either "extremely accurate positioning" of the Charge Coupled Detector (CCD) elements used in detecting the reproduced hologram or the use of, for example, a movable pinhole array placed before the CCD (see Yamaji col 10 lines 32-46). Applicant's amended claims 6, 16 and 26, on the other hand, allow the CCD to be simply positioned at the image plane of the imaging relay lens pair, behind the PRC. In other words, the combination

of Yamaji with Gladney would not result in the present invention because additional components would be required to perform the "extremely accurate positioning" that would be required.

Moreover, because:

(a) the reference beam is collimated and scaled (i.e., by using two imaging relay lens pairs – (1) to compensate for a scale difference between an aperture of an SLM and an aperture of the MEMS mirrors, and (2) one imaging relay lens pair to match a scale difference between the MEMS mirrors and entrance pupil of the PRC);

(b) the first imaging relay lens pair scales an imaging size of the spatial light modulator to match that of an input pupil of the photorefractive crystal; and

(c) the first imaging relay lens images a spatial light modulator image on a plane behind the photorefractive crystal;

it may be concluded the photorefractive crystal and spatial light modulator can be positioned with some degree of freedom by selecting the focal lengths appropriately. For example, f_1 and f_2 may be selected to minimize the spacing between the SLM and the photorefractive crystal. Such a design minimizes the need to strictly align the SLM and the photorefractive crystal, since neither the input beam nor reference beam need to be sharply focussed on the photorefractive crystal. Such design provides significant manufacturing advantages and provides for a higher level of tolerance with respect to alignment and timing of the lens and beams.

In view of the above, Applicants submit that the claimed invention together provides operational advantages over the systems disclosed in Yamaji and Gladney. In addition, Applicants' invention solves problems not recognized by Yamaji and Gladney.

Thus, Applicants submit that independent claims 6, 16, and 26 are allowable over Yamaji and Gladney. Further, dependent claims 7-11, 17-20, and 27-31 are submitted to be allowable over Yamaji and Gladney in the same manner, because they are dependent on independent claims 6, 16, and 26, respectively, and because they contain all the limitations of the independent claims. In addition, dependent claims 7-11, 17-20, and 27-31 recite additional novel elements not shown by Yamaji and Gladney.

V. CONCLUSION

In view of the above, it is submitted that this application is now in good order for allowance and such allowance is respectfully solicited. Should the Examiner believe minor matters still remain that can be resolved in a telephone interview, the Examiner is urged to call Applicants' undersigned attorney.

Respectfully submitted,

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By their attorneys,

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